

90 Miocene genera only 11 now exist (12 percent); of species none. With few exceptions the Miocene species do not continue from one formation to the next. In a geological sense, therefore, mammalian genera and species are short-lived. This being true I hold that it is improbable that all of the species of the list presented lived until the close of the Pleistocene. In that first interglacial stage there were thrown together three incongruous faunas, and it was inevitable that in the struggle for existence some would succumb. This would have happened even if the physical environment were favorable, but with the changes resulting from three or four glacial stages and two or three interglacial stages extinctions would be multiplied.

The fact that the collections from the older Pleistocene deposits show a much higher percentage of extinct forms than from known later ones is evidence that the extinctions occurred at all times. Had all the first interglacial species lived until the end of the Pleistocene, collections from all of the stages would show approximately the same percentage of extinct species.

The history of the Pleistocene animals of Europe shows that the older deposits contain a higher proportion of non-existing species, the majority or all of the earliest deposits being extinct.

Out of the list which has been presented I select the following species as being a part of those of which we find no traces after the close of the first interglacial stage, or at least, after the Kansan glacial stage.

Glyptodon petaliferus	<i>C. vitakerianus</i>
<i>Equus niobrarensis</i>	<i>C. macrocephalus</i>
<i>E. laurentius</i>	<i>C. kansanus</i>
<i>E. excelsus</i>	<i>Eschatius conidens</i>
<i>E. semiplicatus</i>	<i>Camelus americanus</i>
<i>E. calobatus</i>	<i>Elephas haroldcooki</i>
<i>Camelops huerfanensis</i>	<i>E. imperator</i>
<i>C. hesternus</i>	<i>Smilodon nebrascensis</i>
<i>C. niobrarensis</i>	

To these I add the following because they have been found associated with those of the number just given and are evidently of the same geological age.

<i>Smilodon floridanus</i>	<i>Megatherium mirabile</i>
<i>Neochærus pinckneyi</i>	<i>Chlamytherium septentrionale</i>
<i>Stegomastodon mirificus</i>	

Here are listed 22 species of large and important animals of which the writer affirms that they have not been found at any locality the

geology of which can be determined as being later than the first interglacial or the second glacial stages. In support of my position I present the following five sources of evidence.

1. Remains of none of these species have been found in deposits overlying either the Kansan, the Illinoian, or the Wisconsin drift sheets. Many other extinct species have been found in such deposits, ground-sloths, a horse or two, the giant beaver, various species of peccaries, elephants and mastodons. Species of the last list furnished may be found around the borders of these drift sheets; and it is for those who believe in their late existence to explain why these animals did not venture to cross the moraines. The mastodons and the elephants, *Elephas boreus* and *E. columbi*, which more than once were driven from the glaciated regions returned to their old pastures. The camels which inhabited western Iowa did not return.

2. In a fissure in northwestern Arkansas Barnum Brown collected about 50 species of mammals. These appear to have lived about the time of the Illinoian drift stage. Not one of the species of the last list presented was found there.

3. A considerable number of collections of fossil mammals have been made in the Appalachian Mountains from Lookout Mountain, in southern Tennessee, to Frankstown, Pennsylvania. At Lookout Mountain have been found a small horse, a ground-sloth and a tapir. From Winterburg, in northeastern Tennessee, there have been described 18 species of mammals, including 2 horses, a tapir, 3 deer, and *Elephas boreus*. In Wythe County, Virginia, Cope long ago collected 19 species of Pleistocene mammals, among them a megalonyx, a tapir, a horse, a peccary, a bison, and an extinct bear. From a cave in western Maryland the writer has recorded 24 species of mammals, including 2 horses, 6 peccaries, 2 deer, an elephant, probably *Elephas columbi*, and one species of saber-tooth tiger. From a fissure in limestone, near Corriganville, Maryland, Gidley collected 40 or more species of mammals, among them an extinct bear, a mastodon, a horse, a tapir, 5 species of peccaries and many small species of rodents.

Near Frankstown, Pennsylvania, 10 miles south of Altoona, in a limestone cave, were collected by the Carnegie Museum, Pittsburgh, a considerable number of fragmentary fossils, a megalonyx, a tapir, a peccary, a bison, a mastodon, 2 bears, the dog *Enocyon dirus*, a musk-ox, and a horse.

Now all of these collections made in the Appalachian ranges appear to belong somewhere about the middle of the Pleistocene, in possibly

the Yarmouth or the Sangamon interglacial stages. In none of them are there any of the forms which I regard as peculiar to the first interglacial. If these species were then living it is hardly comprehensible that they did not occupy that region. At Nashville a large camel, perhaps a species of *Camelops*, has been found, accompanied by 2 species of horses, a *Mylodon*, and a deer; but these fossils occurred in stratified deposits at a depth of 30 feet and on a level with low water in the river; so that there is no reason for believing that they are not old. The occurrence of these at that locality shows that these animals were once able to visit that region.

4. The Mississippi embayment extends from Cairo to the Gulf. On each side of the river is a deposit which has been called the Port Hudson. In this deposit at various localities have been found important fossils.

From a deposit of blue clay believed to belong to this Port Hudson, and overlain by some 50 or more feet of a later deposit, situated near Natchez, Mississippi, or possibly partly collected from the later deposit, have been described the following seventeen species of mammals:

Megalonyx jeffersonii	Symbos cavifrons
M. dissimilis	Bison latifrons ?
Mylodon harlani	Mammut americanum
Ereptodon priscus	Elephas columbi ?
Equus complicatus	Castoroides ohioensis
E. leidyi	Ursus americanus
Tapirus haysii	U. amplidens
T. terrestris	Felis atrox
Odocoileus virginianus	

In Louisiana, in this Port Hudson, have been discovered at various localities mastodons, elephants, mylodons, megalonyx, horses, and tapirs. These genera and species are such as lived during the middle portion of the Pleistocene. We have, however, no account of there having been found, either in Louisiana, or any of the states bordering on the Mississippi as far north as Cairo, any camels or any of the other extinct animals the writer named as characterizing the first interglacial deposits. They abound, however, in Texas, and again in Florida. On account of the mild climate we might expect to find in this embayment *Megatherium*, *Glyptodon*, *Elephas imperator*, various camels, capabaras and saber-tooth tigers. If they ever left their bones and teeth in this Mississippi River region the remains appear to have been swept away by the floods of that great stream or to have been buried out of sight in its later deposits.

5. There is another important deposit in which we might expect

to find descendants of the early Pleistocene animals named, if there were any such descendants. This deposit, laid down during probably two distinct stages of the early middle and late middle Pleistocene, is known as the loess, a wind-laid element. It is found as a deep deposit along the Mississippi River from Natchez to northern Wisconsin and along the Missouri River to western Iowa and beyond. In places it abounds in land shells, but it has afforded here and there a few vertebrate fossils. In a deposit of loess at Alton, Illinois, the following list of 15 species of mammals were discovered many years ago.

Megalonyx jeffersonii	Bison sp. indet.
Equus sp. indet.	Mammut americanum
Platygonus cumberlandensis ?	Castor canadensis
Sangamona fugitiva	Marmota monax
Cervalces roosevelti	Castoroides ohioensis
Rangifer muscatinensis ?	Geomys bursarius
Taurotragus americanus	Ursus americanus
Symbos cavifrons	

It will be observed that at least two-thirds of these fossils are of extinct species. This suggests that their time of existence was well back in the Pleistocene. Dr. Leighton, who studied<sup>3</sup> the situation, was unable to determine with exactness the ages of the two beds of loess which overlay the bones. The lowest bed may be as old as the late Illinoian or early Sangamon stages. At any rate, none of the species regarded by the writer as belonging to the early Pleistocene are present in the collection.

The writer maintains therefore that he has demonstrated that the list of 50 species of mammals given on page 425 lived during an early stage of the Pleistocene, probably the first interglacial, or Aftonian, and that, further, he has shown that those species have not been found to have existed after that stage.

If we extend now our investigations into Florida we shall find some interesting facts.

At Arcadia many years ago about 25 species of vertebrate fossils were obtained. These consist of 15 mammals, an alligator, turtles, sea fishes, and sharks. The principal mammals are a megalonyx, *Chlamytherium septentrionale*, two species of *Glyptodon*, two horses, a tapir, a mastodon, and two elephants, one of which is *Elephas imperator*. Here we have many of the same genera and some of the same species as we have found in the four localities we have examined west of the

<sup>3</sup> Journ. Geol. 29: 505-514.